

## M&M REFRIGERATION JOB SUMMARY

		REV	<b>D</b>
		REV Date	
JOB NUMBER	<b>07X-044, 10X-046</b>	REPORT DATE	<b>4/15/10</b>
CONTRACTOR	<b>American Refrigeration</b>	SHIP DATE	
CUSTOMER/LOCATION	<b>Stavis Seafoods- Boston, MA</b>	START-UP DATE	

NUM	BOX TYPE		
<b>1</b>	MASTER	<b>1</b>	MODEM
	REMOTES		SLAVES
	MSTR SCREW		MODEM
	STD SCREWS		MODEM
	CSTM SCREWS		MODEM

CUSTOM INFORMATION :	
1	
2	
3	
4	
5	

<b>5</b>	PISTON COMPRESSORS
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<b>2</b>	COMP SEQUENCERS
	SMART SEQUENCE

	ROTARY COMPRESSORS
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	PUMPER DRUMS
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	PUMP PACKAGES
	HANSEN PROBES
	FLOATS

	TRANSFER SYSTEMS
	HANSEN PROBES
	FLOATS

	ANALOGS (ADDITIONAL)
	MONITOR ONLY
	MONITOR & ALRM

	DISCRETES (ADDITIONAL)
	MONITOR ONLY
	MONITOR & ALRM

<b>3</b>	VESSELS
	HANSEN PROBES
<b>7</b>	FLOATS

	CHILLERS
	HANSEN PROBES
	FLOATS

	ICE MACHINES
	HANSEN PROBES
	FLOATS

	BLAST FREEZERS
	HANSEN PROBES
	FLOATS

<b>1</b>	CONDENSER CONTROL			
		FANS		NON-CONDENSABLES
	<b>2</b>	PUMPS		WET BULB
		2-SPEED FANS		<b>1</b> LEAD LIST CHNG ON TEMP
	<b>1</b>	VAR. SPEED FANS		SHELL & TUBE

<b>13</b>	EVAPORATOR ZONES			
		NO DEFROST		OTHER DEFROST
	<b>11</b>	HOT GAS DEFROST		SPECIAL ZONES
	<b>3</b>	AIR DEFROST		<b>2</b> NUMBER DEFR QUEUES

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1	FLOOR HEAT - # PUMPS
	FLOOR TEMP - # SNSRS

6	NH3 DETECTORS
6	MONITOR & ALRM
6	SPECIAL CONTROL

	PEAKHOUR SHUTDOWN
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	THERMAL STORAGE
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	KW MONITORING – CT
	kW MONITORING – PULSE

	PURGER MONITORING
	PURGER CONTROL

	LOAD SHEDDING
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	BATTERY CHARGING
--	------------------

1	EXHAUST FANS
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2	KING VALVES
---	-------------

	SPECIAL FEATURES
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	SPECIAL LOGS
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1	PC MONITORING SYSTEM		1	BASIC SOFTWARE
	COMPUTER			GRAPHIC SCREENS
	MONITOR			MAINTENANCE MGR
	RS-422 BOARD		1	EMAIL ALARM SERVER
			1	NETWORK PC
	PRINTER		1	SYSTEM LOGGING
			1	STD REPORTS
			1	CUSTOM REPORTS
			1	GRAPH PLOTTING

SPECIAL EQUIPMENT/REQUIREMENTS	
1	<b>3 - Additional PC keys were included under 10X-046</b>
2	
3	
4	

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**M&M Refrigeration FAX**

<b>To:</b>	M&M Refrigeration	<b>From:</b>	American Refrigeration / Stavis Seafoods- Boston, MA
<b>Fax:</b>	386-676-7720	<b>Pages:</b>	1 of 1
<b>Phone:</b>	386-676-7335	<b>Date:</b>	
<b>Re:</b>	07X-044 Specification Approval		

☒ Urgent    
 ☐ For Review    
 ☐ Please Comment    
 ☐ Please Reply    
 ☐ Please Recycle

This FAX is provided for your convenience to expedite the specification approval process. Please review the attached specification describing your control system design. If you agree with the specification as written, please sign in the "Approval" box and return this Fax to our office. If there are any changes or concerns, please contact us at your earliest convenience so they can be addressed.

Please supply an estimated startup date \_\_\_\_\_

Do you require approval of electrical drawings prior to shipment (Circle One) YES NO

Thank you for choosing M&M Refrigeration as your refrigeration control system provider

Revision	Date	Approval	Description of Change	Comments
-	4/16/07		Initial Release	
A	4/25/06		Changed HT ACC and Inrcr HLA to XFER Float. Moved ice machines to HT Sequencer	Phone call Giuseppe DiGiallonardo 4/25/06
C	6/22/07	DWK	Changed recip stage to unloaders.	Phone call from Rodger McMahan 6/22/07.
D	04/15/10		Added Email Alarm Notification and delivery of PC Networking software.	10X-046

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## I. Equipment summary:

The following equipment will be controlled and/or monitored by the CCS:

- Standard reciprocating compressor control for 5 reciprocating compressors.
    - All Mycom recip
    - All capacity stages are energize to load
  - Standard sequencer control for 2 sequencers to include
    - HTSG/BSTR interlock
    - Automatic enable/disable based on zone states
    - Max compressor limiting
    - Additional deadband and band width for compressor starting and stopping
  - Standard condenser control for 2 water pumps, 1 variable speed fan and a common pressure sensor. Control Includes
    - Lead list switch on ambient air temperature
    - VFD Fan fault
    - Pumps are primary and standby selectable by the operator
    - Separate defrost setpoints
    - Condenser pump auxiliaries
  - Standard monitoring of a Control Pressure Receiver (CPR) pressure
  - Standard vessel control for an Intercooler (INTCLR) vessel with an Op float, HLA float, HLS float, liquid solenoid valve and transfer solenoid.
  - Standard vessel control for a High Temp Accumulator (HT ACC) vessel with a HLS float, HLA float, and transfer solenoid.
  - Standard vessel control for a Low Temp Accumulator (LT ACC) vessel with a HLS float, HLA float, and transfer sol.
  - Standard control of a transfer system (XFER) with a transfer float and a 3-way valve.
  - Standard evaporator controls for 13 zones (10 hot gas and 3 air defrost) with 2 defrost queues.
  - Standard monitoring and alarm of 6 NH3 sensors to include:
    - NH3 alarm and failure outputs
    - Disable feature used to add zones in the future
  - Standard exhaust fan monitoring and control of 1 fan based on engine room temp and NH3 alarm to include:
    - An exhaust fan override input
    - A conformation switch
  - Standard control of 2 liquid king solenoids (Low Temp, High Temp).
  - Emergency stop monitoring and system shutdown
  - Additional alarm and failure dry contact outputs
  - Standard control of 2 jacket water cooling pumps with auxiliaries and a flow switch with programmable time delay.
  - Standard control of 2 hot water pumps each with an auxiliary.
  - Standard monitoring of a hot water temperature sensor.
  - Standard monitoring of an Ambient Air temperature sensor.
  - Standard monitoring of an Engine Room temperature sensor.
  - Standard monitoring of a glycol pump auxiliary.
  - Standard monitoring of 2 Ice Machine status inputs
- PC Network SW and Email Alarm Notification added under 10X-046

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## II. Control Requirements:

- Compressor control – The CCS will control 5 recip compressors. The names of the recip are as follows:

Comp Number	Compressor Name	Compressor Model	Cylinders
1	BSTR RCB-1	Mycom Recip (40hp)	6
2	BSTR RCB-2	Mycom Recip (40hp)	6
3	HSTG RC-1	Mycom Recip (75hp)	4
4	HSTG RC-2	Mycom Recip (75hp)	4
5	HSTG RC-3	Mycom Recip (150hp)	8

The CCS will control the following I/O for each recip:

Comp Number	Compressor Name	Outputs	Inputs	Capacity Stages
1	BSTR RCB-1	Motor, 2 Capacity Stages	Safety, Motor Starter Aux	33,66,100
2	BSTR RCB-2	Motor, 2 Capacity Stages	Safety, Motor Starter Aux	33,66,100
3	HSTG RC-1	Motor, 1 Capacity Stage	Safety, Motor Starter Aux	50,100
4	HSTG RC-2	Motor, 1 Capacity Stage	Safety, Motor Starter Aux	50,100
5	HSTG RC-3	Motor, 3 Capacity Stages	Safety, Motor Starter Aux	25,50,75,100

The motor starter auxiliary will be monitored and compared to the motor output. An alarm will be generated and the compressor will be failed if the two do not match for more then 3 seconds.

The safety input will be monitored as a normally closed contact. A failure will be generated when the contact is open for more then 3 seconds and the compressor will be shutdown.

A flow switch failure will fail all compressors (See flow switch section below)

The compressors will operate in Manual or Sequenced mode only.

Recip stages are energize to unload

- Compressor Sequencer - Control of 2 compressor sequencer with suction pressure input into the master. The following tables list the sequencer names and the compressors assigned to each.

Sequencer Number	Sequencer Name	Abbreviation
1	Booster Sequencer	BSTR SEQ
2	High Stage Sequencer	HSTG SEQ

The BSTR Sequencer has the following compressors assigned:

Compressor Number	Compressor Name	Compressor Type	Unit Number
1	BSTR RCB-1	Mycom Recip (40hp)	0
2	BSTR RCB-2	Mycom Recip (40hp)	0

The HSTG Sequencer has the following compressors assigned:

Compressor Number	Compressor Name	Compressor Type	Unit Number
3	HSTG RC-1	Mycom Recip (75hp)	0
4	HSTG RC-2	Mycom Recip (75hp)	0
5	HSTG RC-3	Mycom Recip (150hp)	0

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An interlock will be used between the compressors in the booster compressors (BSTR RCB-1, RCB-2) and the high stage sequencer. When the booster compressors need to run, a high stage compressor will be forced to start if one is not already running. If only one high stage compressor is running, it will not be allowed to stop if a booster compressor is running. The booster sequencer will wait until the HSTG suction is below a user adjustable setpoint before it will allow a compressor to start.

Each sequencer will have two lead lists and have the ability to switch the lead list manually or based on the sequencer schedule.

Both sequencers will be able to be ENABLED, DISABLED or placed in AUTOMATIC mode. In automatic, the sequencer will be disabled when all associated zones are satisfied, stopped, or shutdown. This will automatically stop all sequenced compressors. The sequencer will be enabled when any of the associated zones or status I/O indicate unit is in cooling, max cool or defrost. The associated zones are shown in the following table.

Sequencer Number	Sequencer Name	Associated Zones
1	Booster Sequencer	Au 1-3; Ice machine 1 & 2
2	High Stage Sequencer	Au 4-16, Ice machine 1 & 2

The sequencers will have custom load / unload deadband and bandwidth setpoints. One set will be for starting and stopping the compressor and another set will be sent to the compressors for capacity control by the compressors.

Each sequencer will have the ability to limit the number of compressors allowed to run. The operator will be able to set this value on the lead list setup screen.


- Condenser Control - Standard condenser control for 2 pumps with auxiliaries, a variable speed fan with a VFD fault, and one pressure input on the master. The units making up the stages will be referred to as follows:

Name	Abbreviation	Stage
Evaporative Condenser 1	EC1	EC1 Fan
		EC1 Pump 1
		EC1 Pump 2
		EC1 Pump Auto (See Below)

The condenser control will start the VFD fan as more stages are required. The fan will initially run at a user settable minimum speed. The speed of all fans will then be varied using a PID control loop.

The control will support two lead lists to allow for lead list switching on temperature. The CCS will monitor an ambient temperature sensor and will switch from the summer lead list to the winter lead list when the temperature reaches a user programmable setpoint. A separate temperature setpoint will be used to switch back from the winter lead list to the summer lead list.

The master will also monitor VFD fault signals for each variable speed fan. An alarm will be generated when the VFD fault signal is de-energized.

 Note: the VFD enable signals often require isolation relays for proper function. These relays **are not** included in the M&M panel.

The master will also monitor auxiliary contact inputs for the condenser pump. An alarm will be generated if the condenser pump auxiliary does not match the pump output for more than 3 seconds.

An additional stage will be included in the lead list for EC1 PUMP AUTO. If this stage is selected, the user defined primary pump will run. If the primary pump aux alarm is active, the other (Standby) pump will run.

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For the custom condenser pump control when the automatic pump control is selected the used will remove pumps 1 and 2 from the lead list; the default lead list will use automatic pump control.

The condenser control will support 2 sets of control setpoints. One set will be used for normal operation and the other will be used when any zone is in hot gas defrost (PUMP-OUT or HOT-GAS).

4. CPR Pressure Monitoring - Standard monitoring of a CPR pressure transducer. The value will be displayed on a status screen and logged for viewing. No alarm or failure will be generated based on the value of this sensor. A sensor failure will cause an alarm if detected.
5. Intercooler Monitoring and Control - Standard monitoring and control of an intercooler (INTCLR) with an OP float, ~~HLA-XFER~~ float, HLS float, liquid solenoid and a transfer solenoid.

The HLS float will be used to generate a failure and fail **all** the compressors.

~~The HLA float will be used to generate an alarm.~~

The master will open and close the liquid solenoid to maintain the level in the vessel using the OP float.

The CCS requires that one of the compressors associated with the vessel must be available before that package's level will be maintained under normal operation. The operator may override this feature by selecting "YES" for the "MAINTAIN LEVEL WITHOUT COMPRESSORS" option on the vessel setup screen.

The name and abbreviation for the intercooler along with which compressors and zones are attached to it is as follows:

Name	Abbreviation	Compressors	Zones
Intercooler	INTCLR	<u><b>HLS</b></u> RC1, RC2, RC3, RCB1, RCB2  <u><b>Level Control</b></u> RC1, RC2, RC3	No Zones

The intercooler transfer solenoid will be opened when the intercooler ~~HLA-XFER~~ float is open and will remain open for a user programmable time after the ~~HLA-XFER~~ float closes. The transfer solenoid will not be allowed to open when the LTACC HLS failure or HLA alarm is active.

6. High Temp Accumulator (HTACC) Monitoring and control – Standard monitoring and control of a High Temp Accumulator with an HLS float, and ~~HLA-XFER~~ float and transfer solenoid

The HLS float will be monitored and a failure will be generated when the input is open (de-energized). The all compressors will be failed when the accumulator HLS failure is active.

~~The HLA float will be used to generate an alarm.~~

The name and abbreviation for the High Temp Suction Accumulator along with which compressors and zones are attached to it is as follows:

Name	Abbreviation	Compressors	Zones
High Temp Accumulator	HTACC	<u><b>HLS</b></u> RC1, RC2, RC3, RCB1, RCB2	AU4-16, <u>Ice machine 1&amp;2</u>

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The accumulator transfer solenoid will be opened when the HLAXFER float is open and will remain open for a user programmable time after the HLAXFER float closes. The transfer solenoid will not be allowed to open when the LTACC HLS failure or HLA alarm is active.

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7. Low Temp Accumulator (LTACC) Monitoring and Control – Standard monitoring and control of a Low Temp Accumulator with an HLS float and HLA float

The HLS float will be monitored and a failure will be generated when the input is open (de-energized). The booster compressors (RCB-1, RCB-2) will be failed when the accumulator HLS failure is active.

The HLA float will be monitored and an alarm will be generated when the float opens

The name and abbreviation for the Low Temp Accumulator along with which compressors and zones are attached to it is as follows:

Name	Abbreviation	Compressors	Zones
Low Temp Accumulator	LT ACC	<u>HLS</u> RCB-1, RCB-2	AU1-3, Ice Machine 1 & 2

8. LTACC Transfer Systems – Standard transfer system control transferring from the LTACC to the CPR using a transfer float and a 3-way solenoid.

When the vessel is filling, the 3-way solenoid will be de-energized.

When the transfer float contact closes, transfer vessel will pressurize (3-way energized) When the transfer float contact opens, a user-programmable timer will be started. When this timer expires, the transfer will be stopped (3-way de-energized).

The number of transfer cycles per hour will be displayed on a status screen as well as the transfer time for the current transfer cycle.

An alarm will be generated if the transfer remains in progress for longer than a user-programmable time setpoint indicating a transfer system failure.

The name and abbreviation for the transfer system is as follows:

Name	Abbreviation	Associated Vessel
Transfer Drum	XFER	LTACC to CPR

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9. Evaporator Control - Standard evaporator control for 13 zones (10 hot gas defrost, 5 air defrost) using 2 defrost queues.

The evaporator zones are as follows:

Air Unit #	Name	Vessel	Queue	Box	Defrost	Special
1	AU1 FREEZER	LTACC	1	Master	Hot Gas	DX, Liq. S9A, Hot Gas, Bleed, Fan, Temp
2	AU2 FREEZER	LTACC	1	Master	Hot Gas	
3	AU3 FREEZER	LTACC	1	Master	Hot Gas	
4	AU4 COOLER A	HTACC	2	Master	Air	DX, Liq. Fan, Temp
5-6	AU5-6 COOLER A	HTACC	1	Master	Hot Gas	DX, Liq. Suction, Hot Gas, Fan, Temp
7	AU7 COOLER A	HTACC	1	Master	Hot Gas	
8	AU8 COOLER A	HTACC	1	Master	Hot Gas	
9-10	AU9-10 DOCK	HTACC	2	Master	Air	DX, Liq. Fan, Temp
11	AU11 COOLER B	HTACC	1	Master	Hot Gas	DX, Liq. Suction, Hot Gas, Fan, Temp
12	AU12 COOLER B	HTACC	1	Master	Hot Gas	
13	AU13 COOLER B	HTACC	1	Master	Hot Gas	
14	AU14 COOLER B	HTACC	1	Master	Hot Gas	DX, Liq. Suction Fan, Temp
15-16	AU15-16 DOCK	HTACC	2	Master	Air	

Standard evaporator code is used for all the zones with special features added to the required zones as additions to the standard software. All zones contain an option to allow the user to select whether fans cycle with temperature or not, in this way a zone can be set to require the fans to run continuously during the cooling mode.

AU1-3 are direct expansion units and are fed high pressure liquid from the Control Pressure Receiver. These zones will be shut down if no booster compressors (RCB1, RCB2) are available to run. Since a booster compressor requires a high stage to be operational also, the zones will be shutdown if no high stages (RC1, RC2 or RC3) are available also.

 Note: Requires a booster and high stage to be operational.

AU4-16 are direct expansion units and are fed high pressure liquid from the Pilot Receiver. These zones will be shut down if no High Stage Compressors (RC1, RC2, RC3) are available to run.

AU1-3 utilize an S9A suction stop valve requiring a suction open and a suction close solenoid.

AU15-16 is an air defrost unit with a suction solenoid. This solenoid will be normally open and closed during defrost.

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## 10. NH3 Detection - Standard monitoring and alarm of 6 analog NH3 detectors.

All sensors are Manning EC with a linear 4-20mA output.

The master will also create a state for each sensor to be displayed on the status screen. The state (DISABLED, NORM, LOW ALARM, and HIGH FAIL) will be based on the relationship of the sensor value to its setpoints.

The NH3 analogs and associated control for these detectors is as follows:

Sensor	Sensor Name	Box	Type	Control on Alarm
1	NH3 Engine Rm	Master	0-100 PPM	LOW ALARM and exhaust fan control ( See Exhaust fan control ) HIGH FAIL Shutdown Compressor, Disable Condenser, Shutdown Zones
2	NH3 Vent Line	Master	0-10000 PPM	LOW ALARM – Alarm Only HIGH FAIL Shutdown Compressor, Disable Condenser, Shutdown Zones
3	NH3 Freezer	Master	0-200 PPM	LOW ALARM, HIGH FAIL (Shutdown AU1-3)
4	NH3 Cooler A	Master	0-200 PPM	LOW ALARM, HIGH FAIL (Shutdown A4-8)
5	NH3 Cooler B	Master	0-200 PPM	LOW ALARM, HIGH FAIL (Shutdown AU11- AU14)
6	NH3 Dock	Master	0-200 PPM	LOW ALARM, HIGH FAIL (Shutdown AU9-10, AU15-16 )

☞ Note: M&M is **not** supplying the NH3 Detectors

☞ Note: Leak detectors are being powered with 24Vdc being supplied by an additional power supply in the M&M Panel. It is assumed that all sensor required 0.5 Amps of 24Vdc.

Once an alarm condition exists, the operator will need to clear the alarm to allow the equipment to be restarted. The compressors will need to be restarted by the operator. The zones will restart automatically once the alarm is cleared. The control of the exhaust fan will be addressed in the exhaust fan control section.

All leak detector alarms will be inhibited for 3 minutes after a power failure to allow the sensors to warm-up.

The CCS will provide the ability to inhibit all analog leak detector alarms for testing.

☞ Note: many of the NH3 sensors will not be present when the system is initially installed. The disable feature will be used to allow these devices to be added at a later date.

The NH3 alarm output will be energized when any NH3 high PPM failure or low PPM alarm is active.

The NH3 detector failure output will be energized when any NH3 High PPM failure is active.

☞ Note: The leak detector alarm and failure outputs will utilize dry contact output modules. These devices are limited to 1 amp maximum current.

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11. Exhaust Fan Control - Standard control and monitoring of an exhaust fan based on engine room temperature, NH<sub>3</sub>, and an override input.

The CCS will allow the user to enter fan on and fan off temperature setpoints for the fan. The fan will be turned on when the engine room temperature goes above the fan on setpoint and will be turned off when the temperature drops below the fan off setpoint. The engine room exhaust fan will also be forced on when the Engine Room NH<sub>3</sub> sensor records an alarm or the exhaust fan override input is energized. The fan will remain running regardless of the temperature control setpoints until the NH<sub>3</sub> alarm is cleared and the override input is de-energized.

The CCS will monitor an exhaust fan confirmation switch for exhaust fan. An alarm will be generated if the signal does not match the fan output for more then 3 seconds.

12. Low Temp Liquid King Solenoid – Standard control of a low temperature liquid king solenoid valve. The valve will be normally open (energized). The valve will be closed (de-energized) if there are no booster compressors available or the engine room NH<sub>3</sub> high PPM or emergency shutdown failure is active.
13. High Temp Liquid King Solenoid – Standard control of a high temperature liquid king solenoid valve. The valve will be normally open (energized). The valve will be closed (de-energized) if there are no high stage compressors available or the engine room NH<sub>3</sub> PPM failure or emergency shutdown failure is active.
14. Emergency Stop Input - The CCS will monitor an emergency stop input. The signal is assumed to be normally closed. A failure will be generated when the input is de-energized. When the failure is active the master will shutdown the compressors, disable the condenser and shutdown all evaporators and close the liquid king solenoids. When the alarm is cleared, the evaporators will restart when an associated compressor is available and the condenser will restart automatically. The compressors will need to be put back on-line by the operator.
15. Alarm and Failure Outputs - A separate set of alarm and failure outputs will be supplied. These outputs will use dry contact relays to allow them to be connected to the facility alarm monitoring system

 Note: The additional alarm and failure outputs will utilize dry contact output modules. These devices are limited to 1 amp maximum current.

16. Jacket Cooling Pump Control - control of 2 jacket cooling pumps (JWP-1 and JWP-2) with an auxiliary contacts and a flow switch.

If at any time a pump auxiliary contact and the pump output do not match for more then 3 seconds, the pump will be failed and an alarm will be generated.

The jacket cooling pumps will be allowed to run in MAN START, MAN STOP or AUTOMATIC modes of operation. In MAN STOP, the pump will remain stopped until the mode is changed. In MAN START the pump will run until stopped by the operator or failed. In AUTOMATIC mode, the pumps will run based on their order in a lead list. The lead pump will run when any recip compressor is running. If the lead pump is Failed or not in AUTOMATIC mode, the second pump will run.

If at any time flow switch is open (de-energized) when a pump or compressor is running or is closed (energized) when both pumps are off for more then a user programmable delay (Default 10 seconds), a failure will be generated and all compressors will be shutdown.

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17. Hot Water Pump Control - control of 2 hot water pumps (HWP-1 and HWP-2) with an auxiliary contacts.

If at any time a pump auxiliary contact and the pump output do not match for more than 3 seconds, the pump will be failed and an alarm will be generated.

The hot water pumps will be allowed to run in MAN START, MAN STOP or AUTOMATIC modes of operation. In MAN STOP, the pump will remain stopped until the mode is changed. In MAN START the pump will run until stopped by the operator or failed. In AUTOMATIC mode, the pumps will run based on their order in a lead list. The lead pump will run when required based on temperature. If the lead pump is Failed or not in AUTOMATIC mode, the second pump will run.

When in AUTOMATIC the CCS turn require a pump to run when the hot water temperature goes below a user defined "Pump on Below" setpoint. The pump will turn off when temperature rises above a second "Pump Off Above" setpoint.

18. Hot Water Temperature Monitoring - Standard monitoring of an ambient air temperature sensor. The value will be displayed on a status screen and logged for viewing. User programmable high and low temperature setpoints will be provided. ~~The low temperature alarms will be inhibited if the hot water required input is de-energized and for a user programmable delay when it is energized. A sensor failure will cause an alarm if detected.~~
19. Ambient Air Temperature Monitoring - Standard monitoring of an ambient air temperature sensor. The value will be displayed on a status screen and logged for viewing. No alarm or failure will be generated based on the value of this sensor. A sensor failure will cause an alarm if detected.
20. Engine Room Temperature Monitoring - Standard monitoring of an ambient air temperature sensor. The value will be displayed on a status screen and logged for viewing. No alarm or failure will be generated based on the value of this sensor. A sensor failure will cause an alarm if detected.
21. Floor Heat Glycol Pump Auxiliary Monitoring - The floor heat glycol pump aux will be monitored and an alarm will be generated whenever it remains open for more than three seconds.
22. Ice Machine Status Input Monitoring - Standard monitoring of two ice machine status inputs will be provided. These status inputs will displayed on a status screen and use for automatic sequencer control (See Sequencer section Above)

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**Master - Hardware Requirements:**

<b>Hardware Version</b>	3.0
<b>Main Board</b>	Yes
<b>LCD Board</b>	
<b>Display Sub Assembly</b>	1
<b>I/O Expansion board</b>	1
<b>Modem/Comm board</b>	1
<b>Modem</b>	1
<b>I/O Racks</b>	3 – Group 2 32 I/O

<b>Analog Expansion Carrier Board</b>	1
<b>Analog Expansion Board</b>	1
<b>Analog Output Board</b>	1 – 4 Chan
<b>Additional 24V Power Supply</b>	1 NH3
<b>Memory M0</b>	128K EPROM
<b>Memory M1</b>	128K EPROM
<b>Memory M2</b>	512K RAM (Fixed)
<b>Memory M3</b>	

**Analog Outputs:**

<b>Master -- ANALOG OUTPUTS</b>					
OUTPUT TYPE	OFFSET	CHAN	NAME	RANGE	CONTROL DESCRIPTION
4 – 20mA	0	1	EC1 FAN	0 : 100%	PID
	1	2			
	2	3			
	3	4			

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Analog Inputs - Main Board:

MASTER – MAIN BOARD						
TYPE	OFFSET	CHANL	NAME	RANGE	UNITS	SENSOR TYPE
PRESS	0	1	BSTR SEQ SUCT PRESS	0 : 200	PSIA	4/20 mA
PRESS	1	2	HSTG SEQ SUCT PRESS	0 : 200	PSIA	4/20 mA
PRESS	2	3	CPR PRESSURE	0 : 200	PSIA	4-20 mA
PRESS	3	4	CONDENSER PRESS	0 : 500	PSIG	4/20 mA
RM TEMP	4	5	AMBIENT AIR TEMP	-58 : 122	DEGF	4/20 mA
RM TEMP	5	6	ENGINE ROOM TEMP	-58 : 122	DEGF	4/20 mA
RM TEMP	6	7	AU1 FREEZER TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	7	8	AU2 FREEZER TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	8	9	AU3 FREEZER TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	9	10	AU4 COOLER A TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	10	11	AU5-6 COOLER A TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	11	12	AU7 COOLER A TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	12	13	AU8 COOLER A TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	13	14	AU9-10 DOCK TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	14	15	AU11 COOLER B TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	15	16	AU12 COOLER B TEMP	-58 : 122	DEGF	4-20 mA

Analog Inputs - Expansion Board 1:

MASTER – Expansion Board 1						
TYPE	OFFSET	CHANL	NAME	RANGE	UNITS	SENSOR TYPE
RM TEMP	16	1	AU13 COOLER B TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	17	2	AU14 COOLER B TEMP	-58 : 122	DEGF	4-20 mA
RM TEMP	18	3	AU15-16 COOLER B TEMP	-58 : 122	DEGF	4-20 mA
WELL TEMP	19	4	HOT WATER TEMP	32 : 302	DEGF	4-20 mA
MANNING	20	5	NH3 DET VENT LINE	0 : 10000	PPM	4-20 mA
MANNING	21	6	NH3 DET ENGINE ROOM	0 : 100	PPM	4-20 mA
MANNING	22	7	NH3 DET FREEZER	0 : 200	PPM	4-20 mA
MANNING	23	8	NH3 DET COOLER A	0 : 200	PPM	4-20 mA
MANNING	24	9	NH3 DET COOLER B	0 : 200	PPM	4-20 mA
MANNING	25	10	NH3 DET DOCK	0 : 200	PPM	4-20 Ma
	26	11				
	27	12				
	28	13				
	29	14				
	30	15				
	31	16				

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Discrete I/O RACK 1:

MASTER – I/O RACK 1 A/B							
TYPE	H O A	OFFST	CHAN	DESCRIPTION	OFF STATE	ON STATE	NOTES
OUTPUT		0	1	ALARM/FAILURE HORN	NORM	ALARM	
OUTPUT		1	2	FAILURE OUTPUT	NORM	ALARM	
OUTPUT		2	3	ALARM SYS - ALARM	NORM	ALARM	8
OUTPUT		3	4	ALARM SYS - FAIL	NORM	ALARM	8
OUTPUT	X	4	5	EC1 VFD FAN	OFF	ON	
OUTPUT	X	5	6	EC1 PUMP 1	OFF	ON	
OUTPUT	X	6	7	EC1 PUMP 2	OFF	ON	
INPUT		7	8	EC1 PUMP 1 AUX	OPEN	CLOSED	1
INPUT		8	9	EC1 PUMP 2 AUX	OPEN	CLOSED	1
INPUT		9	10	EC1 VFD FAULT	NORM	ALARM	1,4
INPUT		10	11	INTRCLR OP FLOAT	OPEN	CLOSED	2
INPUT		11	12	INTRCLR HLA-XFER FLOAT	ALARM PEN	NORM CLOSED	12,3
INPUT		12	13	INTRCLR HLS FLOAT	ALARM	NORM	2,3
OUTPUT	X	13	14	INTRCLR LIQ SOL	CLOSED PEN	OPEN CLOSED	
OUTPUT	X	14	15	INTRCLR XFER SOL	CLOSED PEN	OPEN CLOSED	
INPUT		15	16	HTACC HLS FLOAT	ALARM	NORM	2,3
INPUT		16	17	HTACC HLA-XFER FLOAT	ALARM PEN	NORM CLOSED	12,3
OUTPUT INPUT	X	17	18	HTACC XFER SOL	CLOSED ALARM	OPEN NORM	2,3
INPUT		18	19	LTACC HLS FLOAT	ALARM	NORM	2,3,2,3
INPUT OUTPUT	X	19	20	LTACC HLA FLOAT	ALARM PEN	NORM CLOSED	
INPUT OUTPUT	X	20	21	XFER FLOAT	OPEN	CLOSED	1
OUTPUT	X	21	22	XFER 3-WAY SOL	CLOSED	OPEN	
OUTPUT	X	22	23	LT LIQ KING SOL	CLOSED	OPEN	
OUTPUT	X	23	24	HT LIQ KING SOL	CLOSED	OPEN	
OUTPUT	X	24	25	JACKET PUMP 1	OFF	ON	
OUTPUT	X	25	26	JACKET PUMP 2	OFF	ON	
INPUT		26	27	JACKET PUMP1 AUX	OPEN	CLOSED	1
INPUT		27	28	JACKET PUMP 2 AUX	OPEN	CLOSED	1
INPUT		28	29	JACKET FLOW SWITCH	OPEN	CLOSED	
INPUT		29	30	GLYCOL PUMP AUX	OPEN	CLOSED	1
		30	31				
		31	32				

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- 1 -Normally open contact with no power or level
- 2 -Normally closed contact with no power or level
- 3 -Failure when open
- 4 -Failure when closed

- 5 – De-energize for condition
- 6 – Energize on condition
- 7 – Pilot driven – Energize to close
- 8 – Dry Contact Module

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Discrete I/O RACK 2

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MASTER -- I/O RACK 2A/B							
TYPE	H O A	OFFST	CHAN	DESCRIPTION	OFF STATE	ON STATE	NOTES
OUTPUT	X	32	1	RCB-1 START STOP	OFF	ON	
OUTPUT	X	33	2	RCB-1 STAGE 1	OFF	ON	
OUTPUT	X	34	3	RCB-1 STAGE 2	OFFOPEN	ONCLOSE D	1
INPUT		35	4	RCB-1 MOTOR AUX	OPENALA RM	CLOSEDN ORM	2,3
INPUT		36	5	RCB-1 SAFETY	ALARMO FF	NORMON	
OUTPUT	X	37	6	RCB-2 START STOP	OFFOFF	ONON	
OUTPUT	X	38	7	RCB-2 STAGE 1	OFFOPEN	ONCLOSE D	1
OUTPUT	X	39	8	RCB-2 STAGE 2	OFFALAR M	ONNORM	2,3
INPUT		40	9	RCB-2 MOTOR AUX	OPENOFF	CLOSEDO N	
INPUT		41	10	RCB-2 SAFETY	ALARMO FF	NORMON	
OUTPUT	X	42	11	RC-1 START STOP	OFF	ON	
OUTPUT	X	43	12	RC-1 STAGE 1	OFF	ON	
INPUT		44	13	RC-1 MOTOR AUX	OPEN	CLOSED	1
INPUT		45	14	RC-1 SAFETY	ALARM	NORM	2,3
OUTPUT	X	46	15	RC-2 START STOP	OFF	ON	
OUTPUT	X	47	16	RC-2 STAGE 1	OFF	ON	
INPUT		48	17	RC-2 MOTOR AUX	OPENOFF	CLOSEDO N	
INPUT		49	18	RC-2 SAFETY	ALARMO PEN	NORMCL OSED	1
OUTPUT	X	50	19	RC-3 START STOP	OFFALAR M	ONNORM	2,3
OUTPUT	X	51	20	RC-3 STAGE 1	OFF	ON	
OUTPUT	X	52	21	RC-3 STAGE 2	OFF	ON	
OUTPUT	X	53	22	RC-3 STAGE 3	OFF	ON	
INPUT		54	23	RC-3 MOTOR AUX	OPEN	CLOSED	1
INPUT		55	24	RC-3 SAFETY	ALARM	NORM	2,3
OUTPUT	X	56	25	EXHAUST FAN	OFF	ON	
INPUT		57	26	EXHAUST FAN CONF	OPEN	CLOSED	1
INPUT		58	27	EXHAUST FAN OVRD	OPEN	CLOSED	1
OUTPUT	X	59	28	HOT WATER PUMP 1	OFF	ON	
OUTPUT	X	60	29	HOT WATER PUMP 2	OFF	ON	
INPUT		61	30	HOT WATER PUMP 1 AUX	OPEN	CLOSED	1
INPUT		62	31	HOT WATER PUMP 2 AUX	OPEN	CLOSED	1
INPUT		63	32	EMERGENCY STOP	ALARM	NORM	2,3

## Notes

1 -Normally open contact with no power or level

5 – De-energize for condition

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- 2 -Normally closed contact with no power or level
- 3 -Normally closed contact open to fail
- 4 -Energize for condition

- 6 – Pilot driven – Energize to close
- 7 – De-energized to turn on via customer supplied relay
- 8 – Dry Contact Module

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MASTER – I/O RACK 3A/B							
TYPE	H O A	OFFST	CHAN	DESCRIPTION	OFF STATE	ON STATE	NOTES
OUTPUT	X	64	1	AU1 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	65	2	AU1 SUCT OPEN	CLOSED	OPEN	S9A
OUTPUT	X	66	3	AU1 SUCT CLOSE	CLOSED	OPEN	
OUTPUT	X	67	4	AU1 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	68	5	AU1 BLEED SOL	CLOSED	OPEN	
OUTPUT	X	69	6	AU1 FAN	OFF	ON	
OUTPUT	X	70	7	AU2 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	71	8	AU2 SUCT OPEN	CLOSED	OPEN	S9A
OUTPUT	X	72	9	AU2 SUCT CLOSE	CLOSED	OPEN	
OUTPUT	X	73	10	AU2 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	74	11	AU2 BLEED SOL	CLOSED	OPEN	
OUTPUT	X	75	12	AU2 FAN	OFF	ON	
OUTPUT	X	76	13	AU3 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	77	14	AU3 SUCT OPEN	CLOSED	OPEN	S9A
OUTPUT	X	78	15	AU3 SUCT CLOSE	CLOSED	OPEN	
OUTPUT	X	79	16	AU3 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	80	17	AU3 BLEED SOL	CLOSED	OPEN	
OUTPUT	X	81	18	AU3 FAN	OFF	ON	
OUTPUT	X	82	19	AU4 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	83	20	AU4 FAN	OFF	ON	
OUTPUT	X	84	21	AU5-6 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	85	22	AU5-6 SUCT SOL	CLOSED	OPEN	
OUTPUT	X	86	23	AU5-6 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	87	24	AU5-6 FAN	OFF	ON	
OUTPUT	X	88	25	AU7 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	89	26	AU7 SUCT SOL	CLOSED	OPEN	
OUTPUT	X	90	27	AU7 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	91	28	AU7 FAN	OFF	ON	
OUTPUT	X	92	29	AU8 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	93	30	AU8 SUCT SOL	CLOSED	OPEN	
OUTPUT	X	94	31	AU8 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	95	32	AU8 FAN	OFF	ON	

**Notes**

- 1 -Normally open contact with no power or level
- 2 -Normally closed contact with no power or level
- 3 -Normally closed contact open to fail
- 4 -Energize for condition

- 5 – De-energize for condition
- 6 – Pilot driven – Energize to close
- 7 – De-energized to turn on via customer supplied relay
- 8 – Dry Contact Module

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MASTER – I/O RACK 4A/B							
TYPE	H O A	OFFST	CHAN	DESCRIPTION	OFF STATE	ON STATE	NOTES
OUTPUT	X	96	1	AU9-10 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	97	2	AU9-10 FAN	OFF	ON	
OUTPUT	X	98	3	AU11 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	99	4	AU11 SUCT SOL	CLOSED	OPEN	
OUTPUT	X	100	5	AU11 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	101	6	AU11 FAN	OFF	ON	
OUTPUT	X	102	7	AU12 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	103	8	AU12 SUCT SOL	CLOSED	OPEN	
OUTPUT	X	104	9	AU12 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	105	10	AU12 FAN	OFF	ON	
OUTPUT	X	106	11	AU13 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	107	12	AU13 SUCT SOL	CLOSED	OPEN	
OUTPUT	X	108	13	AU13 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	109	14	AU13 FAN	OFF	ON	
OUTPUT	X	110	15	AU14 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	111	16	AU14 SUCT SOL	CLOSED	OPEN	
OUTPUT	X	112	17	AU14 HOT GAS SOL	CLOSED	OPEN	
OUTPUT	X	113	18	AU14 FAN	OFF	ON	
OUTPUT	X	114	19	AU15-16 LIQ SOL	CLOSED	OPEN	
OUTPUT	X	115	20	AU15-16 SUCT SOL	CLOSED	OPEN	
OUTPUT	X	116	21	AU15-16 FAN	OFF	ON	
INPUT		117	22	ICE MACHINE 1	OFF	ON	
INPUT		118	23	ICE MACHINE 2	OFF	ON	
OUTPUT		119	24	NH3 DET ALARM	NORM	ALARM	8
OUTPUT		120	25	NH3 DET FAILURE	NORM	ALARM	8
		121	26				
		122	27				
		123	28				
		124	29				
		125	30				
		126	31				
		127	32				

**Notes**

- 1 -Normally open contact with no power or level
- 2 -Normally closed contact with no power or level
- 3 -Normally closed contact open to fail
- 4 -Energize for condition

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## **Questions & Issues: 07x-044**

1.

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